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ABSTRACT

The purposes of this study were to examine the development of classification ability in 36 month olds and to clarify the positive relationship between classification ability and general cognitive development. Subjects, 16 Japanese children (8 males, 8 females), were individually tested by the use of 12 colored pictures of animals and vehicles. Tasks of spontaneous sorting and labeled sorting were administered with triad sets. The subjects' sorting abilities and verbalized reasons for his sorting choices were tested at 2 levels: basic categories such as dogs or cars and superordinate categories such as animals and vehicles. Results indicated that all the subjects named the objects at either the basic or subordinate level but none at the superordinate level. They were able to classify the materials easily at the basic level with a mean percent correct response rate of 92.7, but with difficulty at the superordinate level with a mean percent correct response rate of 52.1. Significant differences were obtained between the two spontaneous sortings and between the spontaneous superordinate sorting and the reasons at the basic level. The positive relationship between classification ability and general cognitive development as measured by the Suzuki-Binet Intelligence Test was confirmed. (Author/MP)

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CLASSIFICATION BEHAVIOR IN CHILDREN THIRTY-SIX MONTHS OF AGE

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Classification behavior has been regarded as a reflection of the development of class concept which is an important domain of cognition. There are two phases in classification: one is intension (i.e., to perceive common and specific properties in the members of a given class) and the other is extension (i.e., to understand the hierarchical relationship between superordinate and subordinate classes). Inhelder & Piaget (1959/1964) noted that while intension emerged during the sensorimotor period, extension developed at a later age and was only fully acquired during the concrete operational period.

According to the previous literature (e.g., Bruner et al., 1966; Inhelder & Piaget), children aged 5 years or less show dominance of intension by perceptual cues in classification. Consequently they have difficulty in sorting materials at the superordinate level such as animal or vehicle. Their superordinate sorting is, however, facilitated by having labels for the categories (Fujishima, 1979; Kitao & Hata, 1971; Sugimura & Kamimura, 1978; Yamaguchi, 1979) or by having the number of materials per category reduced. Rosch et al. (1976) reported that even 4-year-olds responded correctly when presented with a simplified superordinate sorting task with triad sets. Three-year-olds in the same study showed 99% correct responses for basic level classification although only 55% for superordinate classification. Their definition of basic category is the most inclusive category within a hierarchy which consists of items with common attributes and which have similar shapes and actions. This definition includes perceptual properties to a fair degree. In general,

the basic category corresponds to the first level of children's naming.

This study was aimed at examining the development of classification in 36-month-old children with reference to the study by Rosch et al. and to confirm the positive relationship between the development of classification and general cognitive development.

METHOD

1. Subjects

The subjects were 16 Japanese firstborn normal children (8 males, 8 females) from middle-class families. They were selected from the files of the Well Babies Clinic at Kosei Hospital in Tokyo where their neurological, physical and psychological development had been examined regularly. Their cognitive and language development have been followed experimentally in this institute since the age of 6 months.

2. Materials

Twelve colored pictures of animals and vehicles were used and are listed in Table 1. Each picture was painted on a 7 x 7 cm white card in approximately the same size. The colors of the animals resembled those of real ones and the colors of the vehicles were those which are most frequently observed in everyday life. The direction the pictures faced and the color of the pictures for the two subordinate level examples were different (e.g., 2 different colored cars facing in different directions).

3. Procedure

The experiment was conducted in a quiet small room in this institute without any equipment except for the materials needed for the experiment. The subjects were individually tested by a familiar female experimenter in 2 sessions. The first session was within a week after the subject's third birthday and the second was about a week after that. The subjects were divided into 2 groups of equal number and matched for sex. Group I was assigned a basic level sorting task in the first session and a superordinate sorting task in the second session. The order of administering the two tasks was opposite in Group II. In each session, the subject was required to name the objects on the 12 cards prior to the sorting task.

Then a spontaneous sorting task at the basic and superordinate levels was administered. Each task was composed of 6 subtasks in which a set of 3 cards was presented. Two of the three were selected from the same category of a given level and one from a different category on the superordinate level. The triad sets from both levels are shown in Table 2. The instructions were to "put together the two that are alike" for basic level sorting and to "put together the two that are the same kind of things or friends" for the superordinate one. The subject was asked the reasons for his or her classification after each trial of the subtask was presented. The triads were presented until the subject classified correctly twice for a maximum of 3 presentations. The sorting task with category names was then introduced. The set of cards in each subtask was identical to that in the spontaneous task but the instructions were changed to "put together the two that are dogs (an example)" for the basic level sorting and to "put together the two that are animals (an example)" for the superordinate one. The order of presenting subtasks both in the spontaneous and the labeled sortings was randomized across subjects and trials as well as the order of presenting cards within a subtask. The cards were placed in varied arrangement keeping the card itself straight. The experimenter positively reinforced the subjects' performing behavior but treated their responses with neutral words without correcting any errors and recorded the subject's responses on a form sheet.

4. Measurement of General Cognitive Development

The standardized Suzuki-Binet Intelligence Test was administered within a week of each subject's third birthday.

RESULTS

1. Naming of Objects

Naming in the first session was analyzed including baby words (e.g., bow-wow for a dog) and mispronunciations due to the subject's age. All subjects labeled the objects at either the basic or subordinate levels, but none at the superordinate level. Basic and subordinate namings for

the total responses were 78.6% and 21.4%, respectively. While the percentage of correct responses was high in basic naming (96.0%), it was low in subordinate naming (39.0%). Subordinate labeling was observed fairly often (31.3% - 62.5%) for sparrow, sea-gull, golden carp, glider and sailboat. Most of the subordinate namings were correct for sparrow, yet incorrect for the others: for example, goldfish for golden carp or helicopter for glider. In spite of these labeling errors, the subjects' responses were correct in the spontaneous sorting task at the basic level except for one subject whose rate of development was relatively slow and made errors in his naming at the basic level.

2. Development in Classification

When 2 correct responses occurred in a subtask after 2 or 3 trials, the response was regarded as correct. One point was given for each correct classification response and one point for each correct reason in all the subtasks. The scores of Groups I and II were compared and found not to be significantly different for either the basic or the superordinate level tasks ($U=28$, $P > .7$, for the basic level; $U=28.5$, $P > .7$, for the superordinate level; two-tailed). Hence the data from both groups were combined for the analysis below.

1) Analysis of correct responses

As shown in Fig. 1, the mean percentage of correct responses per subject in spontaneous sorting was much higher at the basic level (92.7%) than at the superordinate level (52.1%). Eleven of the subjects gave correct responses in all the subtasks at the basic level but only 3 of them at the superordinate one. Their sorting, however, improved remarkably at the superordinate level when the task categories were labeled. The mean percentage of correct responses went up to 90.6% and the number of subjects without any errors increased to 11. Yet the subjects' verbalization of their reasons showed a low mean percentage of correct responses (13.54% for the basic level and 3.13% for the superordinate one), and none of the subjects responded without any errors.

To sum up the classification abilities of 36-month-olds, they can sort materials with ease at the basic level but have difficulty at the superordinate one. However, they can classify the materials easily even

at the superordinate level when they are given category names. It is quite difficult for them to verbalize the reasons for their classification.

Significant differences were found between mean percentages of correct responses in the two spontaneous sortings ($t=3.295$, $df=15$, $P<.01$, two-tailed), and between those in the spontaneous superordinate sorting and the reasons at the basic level ($t=3.343$, $df=15$, $P<.01$, two-tailed). This suggests that the developmental sequence of classification behavior goes from labeled sorting or spontaneous basic sorting to spontaneous superordinate sorting and then to verbalization of the reasons.

2) Analysis of error responses

The number of subjects who made errors in each subtask is seen in Fig. 2. The number of subjects with errors was small in the labeled and the spontaneous basic sortings. These subjects classified the cards on the basis of colors of the objects in error subtasks, despite their correct namings except for one subject.

The number of subjects with errors increased in the spontaneous superordinate sorting. Subjects made errors based on the similar color or shape of objects in a triad set, such as grouping by shape in subtasks S2 and S4 (tuna and sports car: both are streamlined) or color in subtask S3 (setter and glider: both are brownish). In subtasks S5 and S6 where color or shape could not be used, the subjects resorted to lower level grouping: for example, they put together two of the more familiar objects in a set (e.g., sedan and sparrow in S6), or two adjacent objects in the presentation. Besides, some subjects assembled all 3 cards in spite of the experimenter's repeated instructions to choose 2 cards. This shows that perceptual cues are dominant in spontaneous sorting by 36-month-olds.

Subjects who could not tell the reasons for their classification were included in the group of subjects with errors (5 out of 16). Another 5 subjects answered "because" and 3 of the subjects made tautological responses such as "because they are alike" or "because they are friends". The above 13 subjects persisted in giving the same reason throughout the subtasks. The rest of the subjects, who made correct taxonomic reasons

in some of the subtasks, gave various reasons including tautological responses and insufficient responses in terms of the function of the objects.

3. Relationship between Classification and General Cognitive Development

As a measurement of the development in classification, the total scores of each subject were calculated by giving 1 point for a correct response. The mean total score was 21.0 (SD=4.20, R=28-12). The subjects' IQs were chosen as a measurement of general cognitive development. The mean IQ was 111 1 (SD=9.59, R=128-94). These two variables were significantly correlated ($r=.508$, $P<.025$, one-tailed).

DISCUSSION

The positive relationship between the development of classification and general cognitive development was confirmed in this study. It was also pointed out that perceptual cues were dominant in the spontaneous sorting of 36-month-olds, consequently they could classify objects with ease at the basic level but with difficulty at the superordinate one. These results are in agreement with those of Rosch et al. (1976). In their study, 4-year-olds could easily sort materials at the superordinate level in a triad set. Thus, spontaneous superordinate sorting must develop some time between ages 3 and 4. Yet in this study, the subjects' superordinate sortings were facilitated by having labels for categories. This suggests that errors in spontaneous sorting by 36-month-olds are not due to their lack of superordinate concepts but due to their selective use of perceptual cues for classification. This interpretation is supported by the studies of Nelson (1973) and Goldberg et al. (1974). Nelson reported that 1-year-olds could classify 8 realistic objects (i.e., plastic toys) into animals and eating utensils. Goldberg et al. noted that objects related at the superordinate level were better recalled by 2-year-olds than unrelated objects.

The developmental sequence of classification behavior seen in this study from labeled sorting or spontaneous basic sorting to spontaneous superordinate sorting and then to verbalization of the reasons was pointed

out by Vygotsky (1934/1962) as well, although he did not refer to basic categories and said superordinate concepts were not well developed in children until adolescence. Some of the above processes have been reported in previous studies (Fujishima, 1979; Kitao & Hata, 1971; Rosch et al., 1976; Sugimura & Kamimura, 1978; Yamaguchi, 1979). Nonetheless the order of acquisition is not clear-cut between labeled sorting both basic and superordinate and spontaneous basic sorting. Inhelder & Piaget (1959/1964) noted that intensive classification originates during the sensorimotor period and Cohen & Strauss (1979) demonstrated this in their experiments with 7-month-olds. Thus, spontaneous basic sorting may precede labeled sorting, at least, labeled superordinate sorting. However, further study on this matter is required with younger children.

SUMMARY

The purpose of this study was to examine the development of classification in 36-month-olds and to clarify the positive relationship between classification ability and general cognitive development.

The subjects were 16 normal Japanese children (8 males, 8 females) and were individually tested. Twelve colored pictures of animals and vehicles were used. Tasks of spontaneous sorting, verbalization of the reasons for their choice and labeled sorting were administered with triad sets as well as naming the objects prior to the tasks. The subjects' sorting abilities and reasons were tested at 2 levels: basic categories such as dogs or cars and superordinate categories such as animals and vehicles.

All the subjects named the objects at either the basic or subordinate level but none at the superordinate one. 78.6% of naming was at the basic level with a few errors and 21.4% at the subordinate one with many errors. However, these errors did not affect spontaneous sorting at the basic level. The subjects classified the materials easily at the basic level with a mean percent correct response rate of 92.7, but with difficulty at the superordinate level with a mean percent correct response rate of 52.1. Superordinate sorting was improved by having

labels for the categories. Only 3 of the subjects gave correct responses in some subtasks of the reasons. Significant differences were obtained between the two spontaneous sortings and between the spontaneous superordinate sorting and the reasons at the basic level. The positive relationship between classification ability and general cognitive development measured by intelligence tests was confirmed.

The subjects' errors in the spontaneous superordinate sorting were considered to stem from their selective use of perceptual cues rather than their lack of superordinate concepts. Moreover, the developmental sequence of classification behavior suggested here goes from labeled sorting or spontaneous basic sorting to spontaneous superordinate sorting and then to verbalization of the reasons. However, the order of acquisition of the first two processes remains an open question.

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Table 1 Class Relations of the Materials

Superordinate level	Basic level	Subordinate level	
Animal	Dog	Mongrel	Setter
	Bird	Sparrow	Sea-gull
	Fish	Tuna	Golden carp
Vehicle	Car	Sedan	Sports car
	Airplane	Jet	Glider
	Boat	Steamship	Sailboat

Table 2 Triad Sets of Subtask

Basic level		Superordinate level	
Task No.	Set of cards	Task No.	Set of cards
B1	Mongrel, Setter, Jet	S1	Mongrel, Sparrow, Sailboat
B2	Sparrow, Sea-gull, Steamship	S2	Sea-gull, Tuna, Sports car
B3	Tuna, Golden carp, Sports car	S3	Golden carp, Setter, Glider
B4	Sedan, Sports car, Sparrow	S4	Sports car, Glider, Tuna
B5	Jet, Glider, Golden carp	S5	Jet, Sailboat, Setter
B6	Steamship, Sailboat, Mongrel	S6	Steamship, Sedan, Sparrow

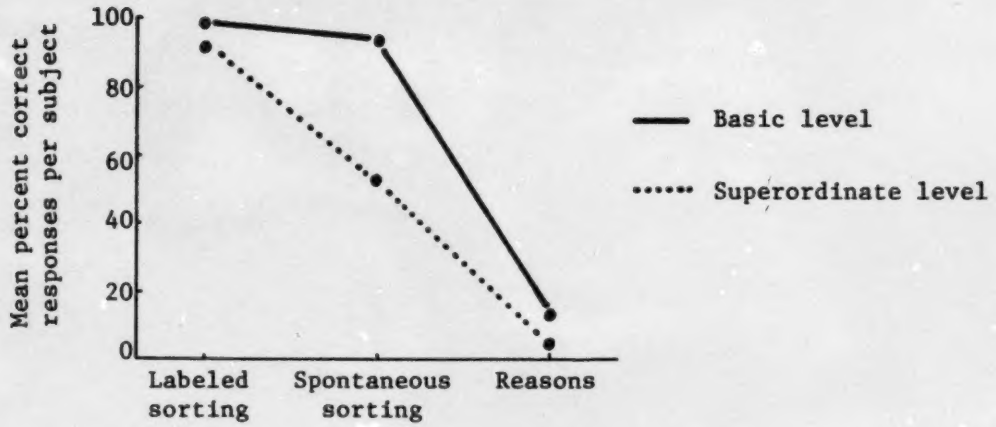

Fig. 1 Correct Sorting and Correct Reasons

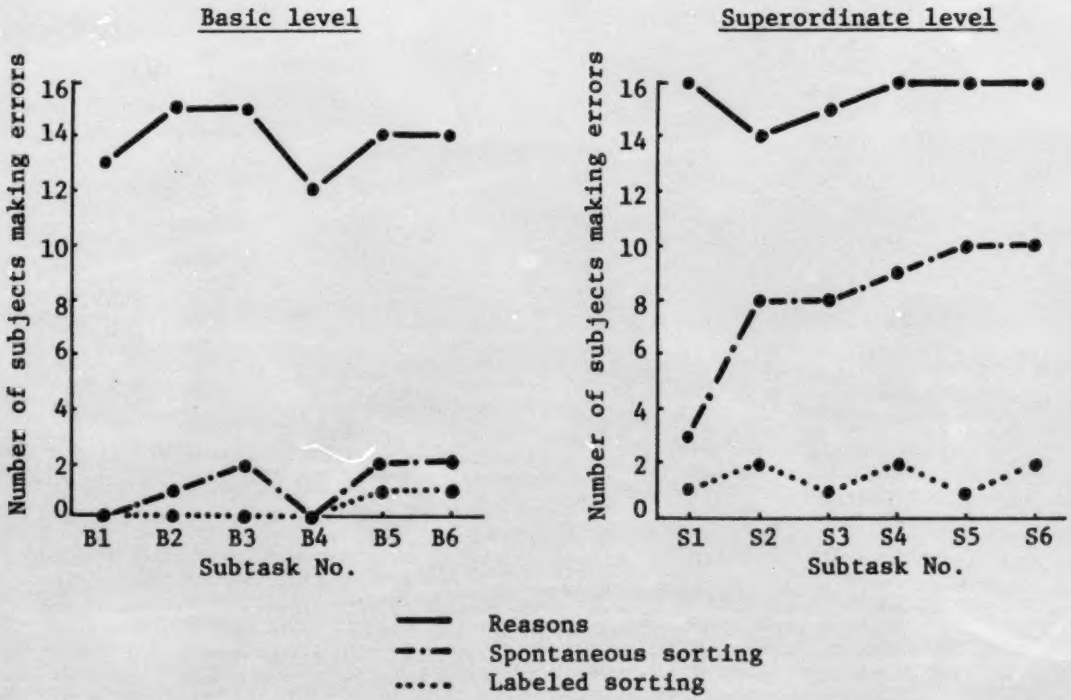

Fig. 2 Errors per Subtask